Space Weather Technical Forecast

Issued on Wednesday, 24 May 2023 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1/R2 radio blackouts. Active fluence expected by 27 May. Slight chance of G1/Minor Storm intervals, especially on 26 or 27 May.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with two M-class flares, the strongest of these a M3.0 flare from AR3311, peaking at 23/1213UTC. Recently an M1.0 flare was observed from AR3311, which produced a possible CME. AR3311 is the largest region on the disc and has stabilised, but remains magnetically complex. AR3310 is large and magnetically stable, but AR3315 appears to be growing rapidly and continues to be monitored. The remaining regions appear simple and stable. A halo CME observed on coronagraph imagery appears to be from a farsided eruption and therefore does not have an Earth-directed component. The possible CME from active region AR3311 will be analysed once sufficient imagery becomes available.

Solar Wind / Geomagnetic Activity: Solar winds observed at L1 have averaged between 550-600km/s due to the influence of a high speed stream from coronal hole 06. Density was around or just below average. Total magnetic field strength was weak throughout, with the important north-south component varying weakly. Phi angle was negative (towards the Sun). Geomagnetic activity was Quiet, with one Active interval between 23/2100-2400UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has remained at background levels throughout. High energy electron flux (greater than 2MeV), as measured at GOES16, reached High levels at the diurnal peak with a maximum of 1600 pfu at 24/1120UTC on a rising trend. The 24-hour integrated fluence has been below Active on a rising trend, with 4.4e7 integrated pfu recorded at 24/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with a chance of further M-class flares. The main risk is from AR3311 near north centre disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs expected, although a weak CME may give some glancing influence later on 26 May or early on 27 May, although the CME is more likely to miss the Earth. Solar winds are currently at elevated levels, likely due to the high speed stream from coronal hole 06. This is a persistent feature from last rotation, and a further increase in wind speed, perhaps up to 650-700 km/s is possible given the wind strength last rotation. Wind speeds are expected to gradually ease through 26 and 27 May, although this decrease may be inhibited by the possible CME. Geomagnetic activity will be mainly Unsettled to Active at first due to the high speed stream influence, with a slight chance of G1/Minor Storm intervals. Activity easing from the high speed stream through the period, but there is a slight chance of G1/Minor Storms on 26 or 27 May should any glancing CME influence occur.

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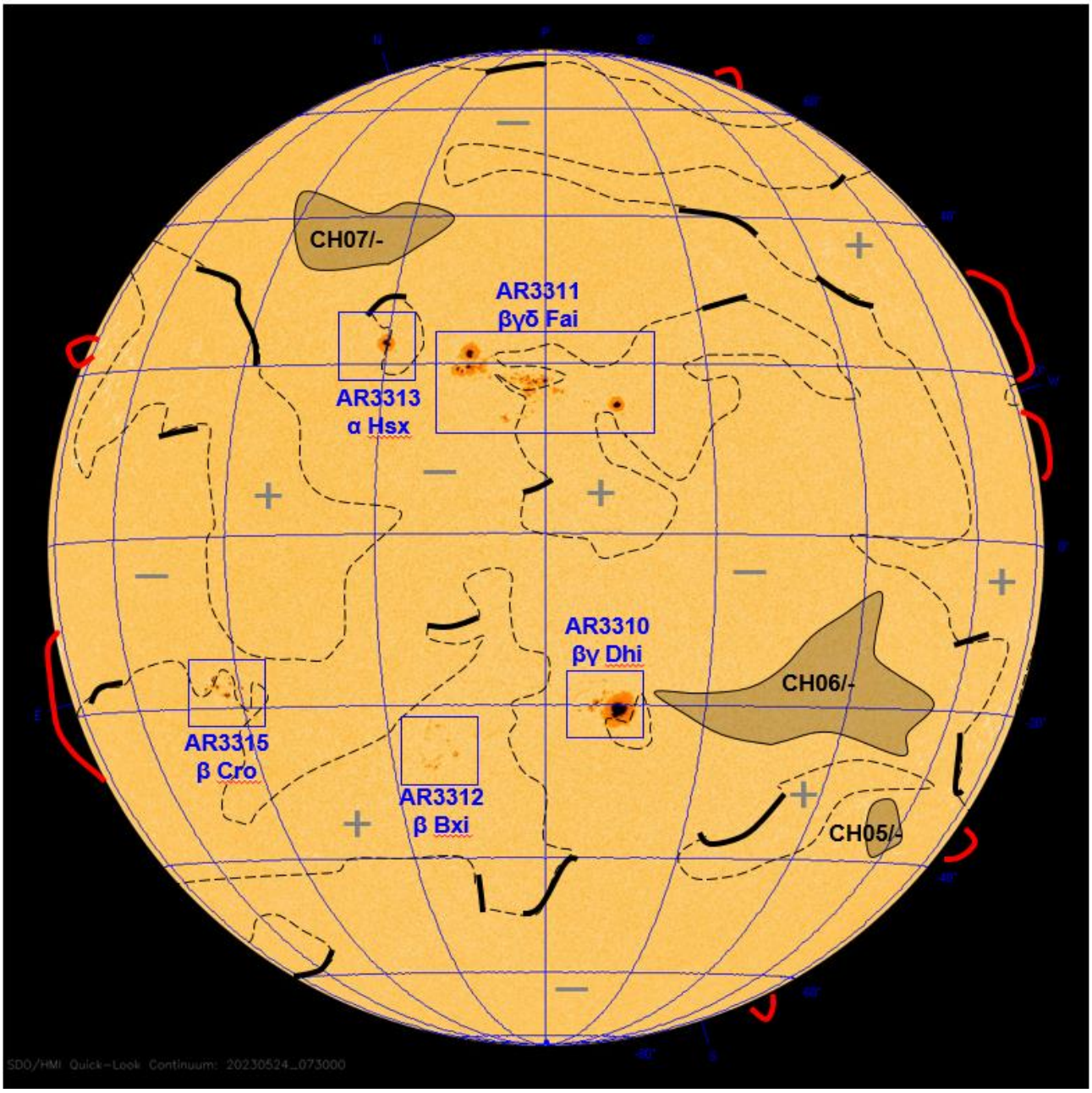
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at background levels, but there is just a slight chance of reaching the S1/Minor Storm threshold should any larger flares occur. High energy electron flux (greater than 2MeV) is expected to continue to reach High levels at the diurnal peaks, with peaks likely rising through the period. The associated electron fluence is also likely to rise, with Active (1e8 integrated pfu) conditions expected by 27 May.

Figure 1. Solar Analysis Valid 24/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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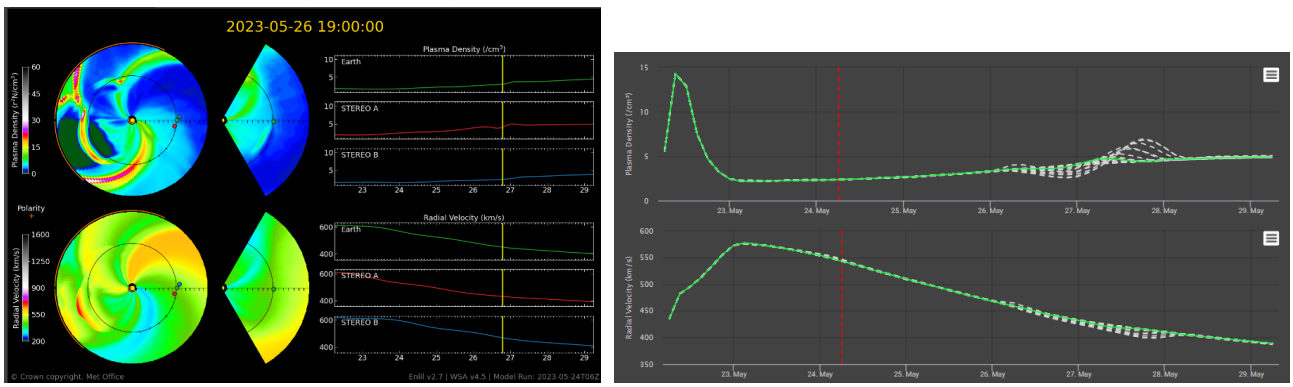
Geomagnetic Storms:
There is a very slight chance of a CME which left the Sun on 22 May affecting Earth on 26 or 27 May, although this is likely to be glancing blow at worst. No further Earth-directed CMEs have been observed on available imagery.

Solar winds are forecast to continue at around 500-600km/s through much of the period, due to the influence of the high speed stream from large coronal hole 06 in the southwest quadrant. Winds may then decline later on 26 or 27 May, although any decline may be inhibited by the possible CME glance.

Geomagnetic activity is forecast to be mainly Unsettled with Active intervals through the period due to the continued high speed stream influence. There is also a very slight chance of G1/Minor Storms in any periods of negative Bz. The risk of G1/Minor Storms later in the period is mainly due to the slight chance of the CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil and Enlil ensemble forecast, showing the possible CME arrival on 26 or 27 May.



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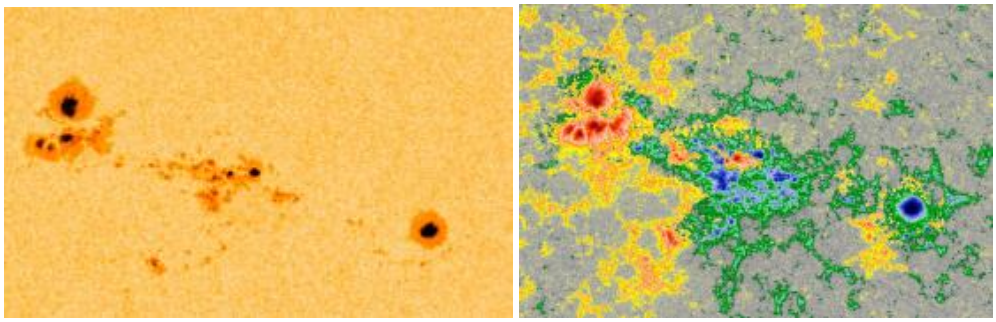
Radio Blackouts - X-Ray Flares:
There are five sunspot regions on the visible disc. AR3311 (Fai/βγδ) is close to centre disc and is the largest and most complex region on the disc. A small but persistent delta region is visible in the centre of the group. AR3310 is a mature region in the southwest quadrant, which appears to have stabilised. AR3315 appears to be growing rapidly and continues to be monitored. The remaining regions are simple of stable. A further region appears to be rotating onto the southeast limb and appears to be active, based on analysis of STEREO-A EUVI data.
Low to Moderate activity is forecast, with a slight chance of High activity and X-class flaring.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: AR3311 in the north-centre quadrant, with the central delta spot circled.



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, has remained at background levels throughout and is expected to remain similar throughout the period.
There is the potential for some enhancement should any larger flares occur, most likely from AR3311 or perhaps AR3310 as they rotate westward through the period, but also from regions that have recently rotated beyond the western horizon. As such a slight risk is maintained throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed at GOES-16 is likely to continue to reach increasingly high diurnal peaks through 24 and 25 May due to the influence of the elevated high speed stream from coronal hole 06. There is less certainty for 26 and 27 May due the potential CME arrival.

Electron fluence is forecast to follow a rising trend and is expected to exceed the Active (1e8 integrated pfu) threshold due to increased electron flux.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	40	50	70	70
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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